Bill Riley's Comments on the Proposed Pebble Mine Predictive Ecological Risk Assessment

prepared for The Nature Conservancy

March 12, 2010

I appreciate the opportunity to provide these comments to the Nature Conservancy on the second draft of the Proposed Pebble Mine Predictive Ecological Risk Assessment. Two years ago I participated in a 'risk workshop' with the TNC board of directors and recommended that TNC pursue developing such an assessment, following the Environmental Protection Agencies guidelines for ERA's. Therefore I am pleased to see that TNC has commissioned this report. In general, I feel the draft ERA does a good job of discussing the life cycle requirements of the five species of salmon and how this mining operation would impact these essential requirements in various ways. I am not a fishery biologist so I can only say the approach seems comprehensive with regard to what salmon require in terms of good habitat, which certainly exists in great abundance in the project area. My comments are directed more at the scope, the scale and the approach of the analysis.

I organized my comments according to the nine criteria, as you have requested. But I should preface them by saying that an ERA can take many forms, depending on the desired scope and scale and to what degree uncertainties in the analysis are addressed. This is generally determined during the 'problem formulation' phase which involves stakeholders such as the TNC board or perhaps a subcommittee or two. Clearly project budget is another factor, particularly when there are so many unknowns regarding design of the proposed mining project. But I believe the analysis would benefit greatly from a more in-depth look at the proposed project and the specific elements and processes that will create the stressors that the report addresses. While there is not at present a 'mining plan' to work from, I believe there is enough information available about the nature of the deposit, the quantities of waste material that would be generated as well as the local topography, hydrology, flora and fauna to do a better job of quantifying the various stressors and hence their significance in terms of risks to salmon and their life requirements.

Review Criteria

1. *Do the lists of physical and chemical stressors adequately represent the suite of important risks of Pebble to salmon? Could you prioritize from this list which ones are the most important to address?*

The stressors are all important, particularly AMD and the potential hydrologic changes that would likely occur during construction and de-watering. That said, the report basically ignores what in my view could be the biggest stressor of all: post-closure hydrologic modifications which could have highly significant consequences in both physical and chemical terms, depending on the volumes of water (both clean and contaminated) that would be discharged (see 2 below).

I would agree with the overall characterization of risk from the various stressors that are discussed, as shown in Figures 29, 30 and 31. However, with respect to fugitive dust, if the ten square miles of tailings ponds are designed for 'sub-aerial' deposition, a disposal method that creates large areas of tailings 'beach', fugitive dust could be a much more significant issue. Given the acid generating nature of the ore, it is more likely that a 'sub-aqueous' method would be employed to slow the rate of tailings oxidation (i.e., keeping the tailings under water). Ideally, both scenarios should be addressed.

2. *Within those sections that you feel qualified to address, is the scope of each stressor adequately addressed?*

As mentioned above, hydrologic modifications following operation have not been considered. The ERA only addresses the'zero discharge' scenario during operations. Even if that was the case, which I seriously doubt, and the mining operation's water requirements would consume every drop of rain that fell on ten square miles of tailings ponds (and their catchment areas) and on hundreds if not thousands of acres of waste rock piles and would consume every ounce of groundwater pumped out of the huge open pit and underground workings, where will that water go after closure? When the mill stops operating and they turn off the pumps, will the pits start to overflow? Will the tailings ponds fill up and overflow? How much contaminated water are we talking about, what could contaminant loadings be and is it possible to capture and treat it all, in perpetuity? If not, what are the risks? See comments under 3 for suggestions to better address this particular stressor.

Chemical stressors are not addressed as well as physical stressors in my opinion. This is primarily because the ERA does not challenge the zero discharge assumption. The water balance/mass balance approach recommended below would address this and likely point out the need for advanced waste water treatment, potentially on a very large scale. And if such treatment was feasible, it could very well introduce major quantities of Total Dissolved Solids (TDS), as is the case at the Red Dog mine. TDS has been shown to have detrimental effects on some species of salmon.

In my experience, average weather conditions are manageable - it is the extremes that can present serious problems for mining operations. High flows can overwhelm storage ponds (e.g., Summitville) and lead to unplanned releases. Similarly, low flows can preclude release of treated waste water due to lack of available dilution water (e.g., Red Dog), resulting in a build-up of waste water that can also compromise storage facilities and treatment capacities. While sizing of ponds, treatment systems and diversion structures may seem to be more of a design consideration, to be addressed at a later time, a discussion of high and low flow storm events that occur in the project area would be helpful to put in perspective the challenges facing project designers. How much freeboard would be needed to contain major storm events? How much treatment capacity would be required? A discussion of 100 year storm events and 10 year drought/low flow scenarios, coupled with the mass balance approach recommended below, would be helpful in my opinion (and the information should already be available).

The discussion of chemical stressors (section 3.2) is very strong in terms of the toxicology of the various metals with respect to salmon. I feel it could be stronger in terms of predicting potential effects rather than expounding on how difficult that is without additional information regarding the geochemistry/reactivity of the mining wastes at issue here. I would certainly agree this is a major challenge but I also feel it would be informative to make some assumptions, with appropriate error/uncertainty bands, regarding potential loadings from the mine pit, underground workings, tailings ponds and waste rock piles, based on a mass balance that is driven by net precipitation (see 3 below).

3. *Within those sections that you feel qualified to address, are there significant flaws in logic? Approach? Technical errors?*

In previous correspondence with TNC I emphasized the critical need for a credible water balance. While I can appreciate how difficult it might be to develop a 'conceptual' water balance, absent participation by NDM and others, one that takes into account average net precipitation in the project area, as well as high and low precipitation/flow scenarios, I would find the ERA much more informative and useful if it were based on rough mass balances of contaminants from several sources: tailings ponds, waste rock piles, open pits, underground workings as well as road construction, etc. These could be generated with credible side boards in terms of uncertainty, producing a range of potential contaminant loadings to area streams.

The most critical omission in the report is a discussion/analysis of annual net precipitation. In an area receiving approximately 36" of precipitation per year, how much is lost through evaporation? More importantly, what is a reasonable water balance, however crude at this stage, for the operation? If 33 square miles would be disturbed, how much contaminated runoff would that produce? Can it be predicted by drainage basin and by month (on average with error/uncertainty bands)? For instance, if there are to be 10 square miles of tailings ponds, what is a reasonable rate of flux of metals to the water column, and how much of that water would overflow? There are metrics that can be applied here as well as to discharges from the hundreds, perhaps thousands, of acres of waste rock piles, pit water discharges and potential flooding and seepage from underground mine workings. This type of mass balance approach, though fraught with uncertainty, would help to quantify potential chemical loadings to nearby streams, during and following operations. It would also require some assumptions about level of waste water treatment required and for how long.

I believe the document would benefit greatly if the various stressors were discussed according to the project phase in which they occur, i.e., construction, operation and closure/post-closure. The impacts can vary considerably. For instance, I would expect sedimentation and turbidity would be key stressors during construction, de-watering and low flows/hydrologic impacts during operation and then AMD/metals contamination after closure when the mill and pumps are turned off. It would also be very helpful if the impact predictions were bracketed with best case vs. worst case scenarios to capture the range of uncertainty and help focus on those critical areas where more data/information is needed to develop a more accurate, credible analysis.

I would suggest that discussions of spills, pipeline breaks and tailings dam ruptures/failures be confined to a separate chapter or section. The ERA should address these potential accidental releases but they do not constitute on-going processes that are part of a typical mining operation, although they do unfortunately occur.

I would also suggest incorporating the discussion of AMD into the section on chemical stressors. AMD is clearly a driver in terms of metals contamination and seems to be 'hanging out' on its own following discussions of potential upset conditions. With respect to the AMD discussion, however, am I correct that here (p. 100, paragraph 2) the report assumes a return to pre-development flows? This bears much more discussion and analysis and again gets back to the water balance/mass balance approach I have suggested that looks at each major project component/source of contaminants and what flows and loadings could reasonably be expected during the three phases of the project: construction, operation and closure/post-closure.

The discussion of potential impacts from fugitive dust (section 3.2.2) goes on to discuss erosional impacts which are water driven, not wind driven. I found this section, which goes into great detail in attempts to quantify potential impacts, somewhat confusing. Since precipitation runoff is the critical medium for moving the dust particles into nearby streams, it would seem much more amenable to incorporation into an overall mass balance with fugitive dust being one source of contamination, along with pit water, tailings water, waste rock runoff, etc.

Despite the comments above, I thought the summary and cumulative impacts analysis were well done. The document contains quite a bit of technical discussion, some case studies and lots of 'science' that many could find hard to follow. But the executive summary, and the Summary, Conclusions and Cumulative Effects were very understandable.

4. *General critique on tone?*

I felt the document struck a good, balanced tone. In my opinion the ERA is quite professional in presentation.

5. *Please comment on the overall technical merit of the document.*

Obviously I feel the document missed the mark on the post-closure phase and in ignoring the 'elephant in the room', i.e., will waste water treatment be required and is it really feasible on such a huge scale? Some sections go into much greater detail than others but that is not surprising given that it was presumably written by multiple authors (the authors should be listed, along with their qualifications). Also, while there is plenty of documentation, there is currently no list of references. I assume that will be corrected but it would have been helpful to have it incorporated in this version. Methods and approaches employed all have merit in my opinion (e.g, the HEP approach using HSI's) though I'm certain others with a better technical background in fisheries biology, and perhaps geochemistry, could take issue with some of them (e.g., assuming AMD with a pH of 4 based on what's happened at the Bingham copper mine in Utah).

6. *Please comment on how the document is or is not effective in raising awareness of risks of the mine to salmon.*

I think it's very effective, especially the Summary, Conclusions and Cumulative Effects section at the end of the document. Many will argue with some of the conclusions but associated rationale and documentation are generally good and presumably defensible. Figure 31 does a great job of summing things up and looking at impacts over time.

7. *How do you think industry will react to this document if the above aspects are solidly corrected/addressed in a final document? Which sections are they most likely to dismiss out of hand? Which sections might they find to have a substantive point?*

Industry will no doubt consider this ERA quite pre-mature, given the lack of mining operation details at this time. But given what is at stake, not just the world class salmon runs but the well being of the people who depend on the salmon for survival, I believe it is highly justified and very much needed, if for no other reason than to open up a dialogue. As I understand it, NDM's promise of an 'open process' and full disclosure has been anything but that. They will argue that they will use the best mitigation possible, that there is plenty of neutralizing material available to offset the potential for AMD and that they are committed to meeting all regulatory requirements (e.g., meeting all water quality criteria). They will object to the AMD scenario (pH 4 runoff) and the cumulative effects analysis that assumes two slurry pipeline failures and one major tailings release. They will commit themselves to treatment in perpetuity, if needed, while arguing no doubt that it won't be needed. But they will probably concede the hydrologic impacts during construction and operation are legitimate since the report takes NDM's flow depletion estimates as a given and uses them as a primary driver for the analysis.

8. *I also welcome other critiques you may develop as you read through this document.*

Clearly a project of this magnitude will be a very expensive proposition. As I recall, the mineral deposit, while quite vast, is not a rich deposit, i.e., the target minerals are present in very low concentrations (unlike Red Dog). The report does not address the potential for intermittent shut down of operations due to a drop in metals prices. This again gets back to the water balance question. As occurred at Grouse Creek, shutting down the mine temporarily due to low gold prices during the '90's resulted in a positive water balance and a subsequent need to de-water the tailings pond before it overflowed. It became a Superfund site. The report could address this scenario.

Lastly, while it is not an ERA issue, the question of financial assurances should be very much 'on the table'. The ERA points out some very large risks that will be very expensive to manage. Who will pay for all the mitigation, restoration, etc., if the mining company should go belly up? Who will assure adequate funding for proper closure, assuming that is even possible?

9. *No editorial or formatting review required. We have an editorial team that is currently reviewing the document from an editorial perspective. I know that there are some formatting issues in the document these are being addressed.*

I have suggested a couple of ways of re-organizing the document. I hope they are helpful.